Office Development, Parking Management, and Travel Behavior: The Case of Midtown Atlanta

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ABSTRACT

The effects of special parking provisions in zoning ordinances are assessed based on a case study of Midtown Atlanta. The study results indicate that it is somewhat easier to promote increased office development around rail transit stations than it is to reduce parking construction associated with such office development. It also appears that spill-over parking is a much more likely commuter response to parking pricing than is alternative mode use, especially where the private automobile is the dominant mode of commuter transportation and reasonably priced alternative parking lots are conveniently located.

INTRODUCTION

Zoning ordinances often require more parking than is required to serve the access needs of new development (Shoup and Pickrell 1978). The result in most suburban office settings is ample free parking or, from a different perspective, the absence of parking pricing needed to discipline travel markets (Shoup 1982). Even in central business districts

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(CBDs), where parking pricing is the rule rather than the exception, as much as half or more of all employees may receive free parking, either directly provided or reimbursed by their employers (Roche and Willson 1986).

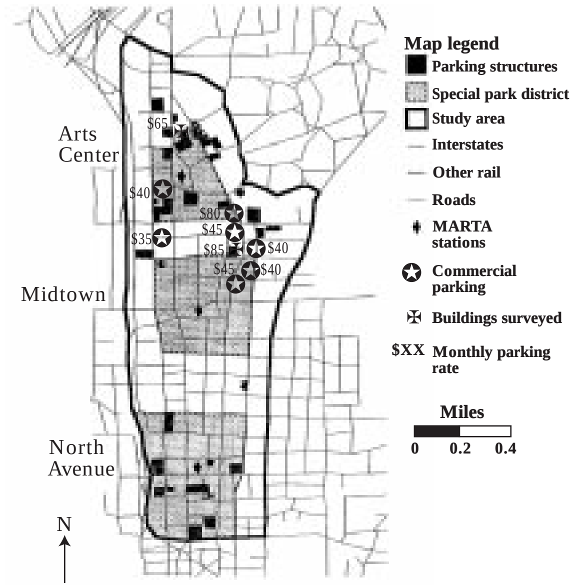
Transportation influences land use by allowing higher density development as greater accessibility is provided (Giuliano 1989). Beltways have transformed many urban areas. Suburban highway junctures can develop into employment centers rivaling the CBD in terms of both size and influence (Payne-Maxie and Blayney-Dyett 1980). Rapid rail transit is posited to have similar effects, though perhaps on a somewhat smaller scale (Cervero and Landis 1993).

Local communities often attempt to steer development through zoning ordinances, providing tax breaks, density bonuses, and other incentives to attract certain types of development activity to specific locations within their jurisdiction (Forkenbrock 1990; Cervero 1994). Atlanta, Georgia, is one such city. The city of Atlanta modified its zoning ordinance in 1981 to promote economic development by easing restrictions on building construction near rapid rail stations. An example of this is the elimination of all parking requirements in redevelopment zones called Special Public Interest Districts (SPIDs). This paper will analyze the local effects of SPIDs on land development and travel behavior in Midtown Atlanta.

Data

The data used in this analysis were derived from a case study of Midtown Atlanta, a major employment center in the city of Atlanta, located just four miles north of the traditional CBD (Nelson et al. 1995). For the purposes of this study, a cordon line was draw around three nearly contiguous SPIDs in the Midtown area: the North Avenue, Midtown, and Arts Center rail stations. Preliminary data on availability, occupancy, and pricing were collected for all high rise office buildings and commercial parking facilities located in the study area through a combination of telephone interviews and windshield surveys. Two sites were identified within the study area's boundaries for further analysis, based on detailed employer and employee surveys. Each site selected was composed of two adjacent buildings. The first site was located just inside, the second site just outside, Midtown's SPID boundaries (see figure 1).

FIGURE 1 Midtown Study Area



Employers located at both sites were surveyed regarding employee parking policies. Of the 74 tenants in the 4 buildings surveyed, 29 returned surveys for an overall 39% response rate. Employees of all building tenants were surveyed simultaneously regarding mode of travel to work, parking, and related issues. Of the 74 tenants resident in the 4 buildings, 36 (49%) returned 1 or more employee surveys. Of the 674 employees of these 36 responding firms, 350 (52%) returned employee surveys. This response rate is adequate to ensure a representative sample of employees and employers within the sites selected.

Methodology

The methodology employed here is simple and straightforward. We have a single study area composed of a unified land market in a fairly homogeneous neighborhood commonly recognized as such and therefore called Midtown. Within the study area there are three SPIDs. Buildings, building tenants, and their employees must be either inside or outside an SPID.

We will look at the dynamics of speculative high rise office development inside and outside SPIDs within the Midtown study area. In addition, we will also analyze travel behavior and parking utilization among employees inside and outside SPIDs within the Midtown study area.

The following hypotheses will be tested:

Group I

1. SPIDs increase development
2. SPIDs reduce parking supply
3. SPIDs increase parking pricing

Group II

4. SPIDs modify travel behavior
5. SPIDs encourage transit use

The first three hypotheses can be tested explicitly based on analysis of a full inventory or a census of the local market for commercial office space before and after SPID implementation. The last two hypotheses require the use of statistical methods applied to a survey sample of employees inside and outside SPIDs. The statistical methods used here include categorical analysis based on cross-tabulation and non-linear regression analysis using the logit model.

The mode choice model used is a basic logit model of the following form:

$$P = e^U / (1 + e^U)$$

where

P = probability of mode choice, and

U = utility of mode choice

for the binary mode choice case. Most of the choices modeled here are binary. Mode choice for work trips is modeled as three mutually exclusive levels of alternative mode use: a) never, b) occasional, and c) regular. Mode choice for non-work trips is modeled as four non-exclusive binary choices: rail, bus, walk, and bicycle. Parking location is modeled as a single binary choice: a) onsite and b) offsite.

These dependent variable specifications are quite simple and largely data driven. Further breakdowns by specific alternative modes for work trips or specific trip purposes for non-work trips were hindered by the limited variability available in this particular data set. The results presented here are, for the most elaborate models, consistent with the initial construction of implicit hypotheses as embodied in the original survey instrument and the limitations inherent in the actual data.

Parking location and mode choice can be modeled simultaneously (Westin and Gillen 1977). In this analysis, these two elements of travel demand are treated separately, mainly because of limited variability in mode choice among the few regular users of alternative modes found in Midtown Atlanta. In order to model parking location and mode choice together, it would be necessary at the very least to separate travel modes into those that require parking and those that do not. The overwhelming reliance of Midtown Atlanta commuters on the solo driven private automobile creates a lot of statistical power sufficient to model parking location.

THE BUILT ENVIRONMENT

The Atlanta metropolitan region, with a population of more than 3½ million in 1997, is one of the 10 largest urban areas in the United States, as well as one of the fastest growing. The city of Atlanta, with a population barely exceeding 400,000, is one of the smallest central cities in the United States and among the most stagnant in terms of population growth. The city of Atlanta actually declined in population in the 1970s, stabilizing somewhat only after 1980. Meanwhile, the surrounding Atlanta suburbs have grown by leaps and bounds. Annexation is not a serious option for Atlanta, due to special provisions of the state constitution that make both local annexation efforts and the incorporation of entirely new cities unusually difficult to accomplish.

The Midtown area was one of Atlanta's first true residential suburbs. It was laid out by upscale developers in the early part of the 20th century, just four miles north of the original CBD. The Midtown area was annexed by the city of Atlanta after World War I and grew to maturity as one of its most prestigious residential neighborhoods. The first office boom in Midtown occurred in the late 1960s, with 7 buildings of 8 to 24 stories going up between 1964 and 1974. Midtown developed a bad reputation in the late 1970's as the aging housing stock suffered a serious decline. In the 1980s, Midtown residential property values rebounded as Yuppies moved in, becoming urban pioneers of sorts. Meanwhile, Midtown's second office boom ran from 1986 to 1994, with 10 new office towers of 10 to 50 stories augmenting the Midtown skyline.

The Midtown area has excellent access to both highways and public transit (see figure 2). The "Connector," a short, merged link of I-75 and I-85, runs directly adjacent to the area on the west side, with two full-service Midtown exit ramps, including partial access roads both north and south. The Metropolitan Atlanta Regional Transportation Authority (MARTA) is a combined rail and bus transit system. Over 90% of MARTA's bus passengers are routed to the rail system by design, making MARTA one of the most rail-dominated transit systems in the world. There are three MARTA rail stations in the Midtown area, strung together like beads on a string and closely spaced along Peachtree Street, the central traffic artery running from the CBD through Midtown and Buckhead all the way out to the farthest northern suburbs.

FIGURE 2 MARTA Service Area

MARTA was created by an act of the Georgia State Legislature in 1965, with a mandate to operate existing bus service while planning and implementing a proposed rapid rail system in and around Atlanta. The rail system plan was completed in 1971. A referendum to support construction of the rail system through the institution of a regional 1¢ sales tax was approved by voters in Fulton and DeKalb counties but rejected by voters in Cobb and Gwinnett counties. Portions of the east-west rail line opened for service to the general public in 1979. The north-south rail line opened shortly thereafter, with service to the three Midtown rail stations starting in 1981 and 1982.

Special Public Interest Districts

In 1981, the city of Atlanta established SPIDs around MARTA rail stations in three sections of the city: Downtown, Midtown (the study area), and Buckhead (see figure 2). The purpose of all three of these SPIDs was to promote high-density commercial office development in conjunction with the location of MARTA rail stations:

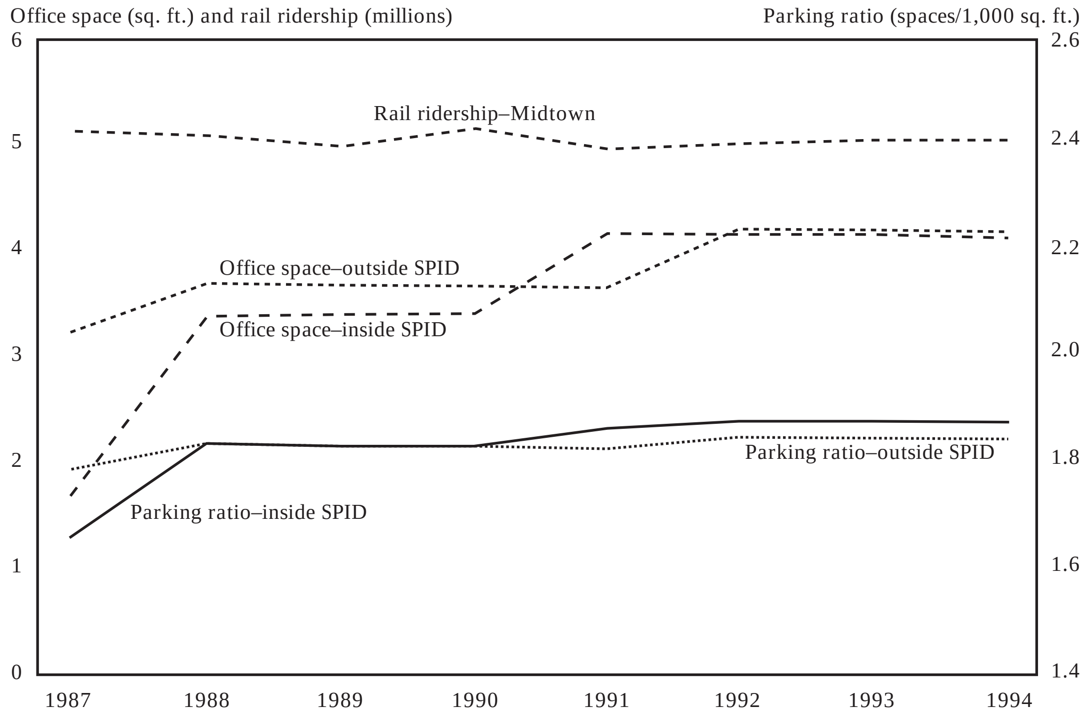
1. Developments inside SPIDs were freed from any parking requirements whatsoever, and were allowed to build to any height desired under permissible density restrictions.
2. Developments outside SPIDs were required to construct a minimum of 2 parking spaces per 1,000 square feet of commercial office space, and existing height restrictions effectively limited buildings to 30 stories or less.

SPID boundaries were drawn approximately 1,000 feet around each MARTA rail station, with major street thoroughfares used as the actual dividing lines. Walking distance to MARTA was thus the default criterion used to determine whether any particular proposed development project fell inside or outside the domain of SPID provisions (see figure 1).

Office Development

The Midtown office market was dormant both during and after the deep economic recession that struck the nation in the early 1980s. It was not until 1986, five years after SPIDs were first put in place, that the Midtown office market began to revive. At the beginning of this new office development cycle, there were 4.8 million square feet of

FIGURE 3 Midtown Office Development



commercial office space available in Midtown, two-thirds of which was located outside SPID boundaries (see figure 3). Parking ratios for preexisting office developments were 1.65 inside and 1.78 outside SPIDs.

During the occasionally frenzied land speculation and office development activity that occurred in Midtown in the late 1980s, a net 3.5 million square feet of office space was added to the preexisting stock. Just over 70% of this new office development occurred inside rather than outside SPID boundaries. Given more than sufficient availability of vacant and underutilized land in the Midtown area, SPIDs, it seems, had been successful in promoting office development within comfortable walking distance of MARTA rail stations.

There was one problem. New Midtown developments outside SPIDs built an average of 2.07 parking spaces per 1,000 square feet of commercial office space, barely above the minimum requirements set by the city. Interestingly, however, new Midtown developments inside SPIDs built an average of 2.03 parking spaces per 1,000 square feet of commercial office space, barely distinguishable from new developments outside SPIDs and certainly well above the city's requirement of zero. Far from building no new parking, Midtown developers inside SPIDs added parking at virtually the same rate as did their local competitors outside SPIDs. Based on this evidence, one cannot conclude that SPIDs resulted in any decrease in the availability of Midtown parking at all.

Building Management

Building managers influence employee travel behavior primarily through parking policies. Building managers may choose to charge for parking, provide it free of charge, or include it in signed lease agreements. They may restrict parking to tenants, employees, and their visitors or open it up to anyone who happens to pass by. Building managers can reserve some, all, or no parking for tenants and their employees. Building managers who charge for parking may do so on an hourly, daily, weekly, or monthly basis.

Shoup (1982) found that free employee parking is almost always bundled with long-term office leases, at least in Southern California. Building managers in Midtown Atlanta generally provide no free parking, either to tenants or their employees, with or without long-term office leases. This practice seems to be a basic condition of the local market, applicable to all Midtown office buildings, not just those included in the present study. Midtown tenants are given the option to reserve parking for their employees, up to a limit of 2 parking spaces per 1,000 square feet of leased office or retail space. Any such "reserved" spaces must be paid for separately and in addition to the office lease, either by the tenant or the employee.

Commercial parking rates in Midtown Atlanta varied widely in 1995, from \$1.25 to \$8.50 on a daily basis, and from \$22.50 to \$85 on a monthly basis depending on location and site-specific amenities. The four buildings included in this analysis were toward the high end of this scale, with maximum daily rates of \$6 and \$7.50 and regular monthly rates of \$65 and \$85, inside and outside SPIDs, respectively. Commercial parking lots with daily rates of \$2 to \$4 and monthly rates of \$30 to \$40 were concentrated mainly in the central Midtown area (see figure 1). Several inexpensive surface commercial parking lots were immediately adjacent to Site 2, located just outside the central Midtown SPID, while only one such lot, located just inside the northern Midtown SPID, was within convenient walking distance of Site 1.

EMPLOYEE DEMOGRAPHICS

The demographics of the two sites surveyed were reassuringly similar (see table 1). Employees inside SPIDs were significantly more likely than those outside to hold professional job titles and to have attended some graduate school. Employees inside SPIDs were slightly older than those outside, with higher incomes and more autos, and more likely to live in the suburbs. None of these latter differences were statistically significant, even at the 0.10 level, though age and auto availability bordered on statistical significance.

Overall, it appears that the demographics of the two sites were almost, but not quite, identical. It appears that employees inside SPIDs were perhaps slightly more "upscale" than those outside, but this tendency, if one can even call it that, was mathematically weak, and therefore unlikely to skew the numerical results or invalidate the experimental design. Midtown employee demographics were comparable to both the Atlanta region and the United States as a whole. Major differences includ-

TABLE 1 Demographics by Site

Demographics	Percentage of employees: Inside SPID	Percentage of employees: Outside SPID	χ^2 (d.f.)†
Profession:			
Manager/supervisor	20.3	29.6	
Professional/technical	46.0	30.3	9.23 (2)***
Other	33.7	40.2	
Age:			
Under 30	32.6	33.3	
30–39	28.8	37.3	3.88 (2)
40+	38.6	29.4	
Gender:			
Male	34.2	38.7	
Female	65.8	61.3	0.74 (1)
Race:			
White	85.4	81.0	
Non-white	14.6	19.0	3.10 (1)*
Education:			
Some graduate school	45.7	31.2	
Some college	47.3	60.4	
No college	7.0	8.4	7.56 (2)**
Annual household income:			
<\$30,000	33.9	39.1	
\$30,000–74,999	27.1	23.9	0.98 (2)
>\$75,000	39.0	37.0	
Household auto availability:			
N cars < N adults	8.7	11.2	
N cars = N adults	66.7	72.4	3.53 (2)
N cars > N adults	24.6	16.4	
Residential location:			
Fulton/DeKalb counties	59.8	62.5	
Cobb/Gwinnett counties	25.7	24.3	0.27 (2)
Other	14.5	13.2	

† level of significance
* significant at 0.10 level
** significant at 0.05 level
*** significant at 0.01 level

ed a higher proportion of women than the national average and a lower proportion of minorities than the Atlanta average.

Working Conditions

Unlike demographics, which varied consistently if slightly, working conditions varied either tremendously or not at all by site location (see table 2). Length of employment and the average amount of time spent at work in an average day were virtually identical inside and outside SPIDs. Workers inside SPIDs had greater flexibility in choosing when to start their work day and were more likely ever to have worked at home. It appears that the slightly more upscale workers inside SPIDs had much greater autonomy in selecting key aspects of their employment conditions.

TABLE 2 Working Conditions by Site

Working conditions	Percentage of employees: Inside SPID	Percentage of employees: Outside SPID	χ^2 (d.f.)†
Length of employment:			
< 12 months	32.8	28.9	
12–35 months	35.5	40.1	0.90 (2)
> 36 months	31.7	30.9	
Average time spent at work:			
< 9 hours	28.1	28.1	
9–9.5 hours	42.7	41.1	0.12 (2)
> 9.5 hours	29.2	30.8	
Flexibility in arrival time:			
< 15 minutes	20.9	35.7	
15–30 minutes	51.6	54.5	19.23 (2)***
> 30 minutes	27.5	9.8	
Ever worked at home:			
No	42.9	62.4	
Yes	57.1	37.6	13.11 (1)***
Who pays for parking:			
Employer pays	56.8	25.5	
Shared cost	15.1	6.4	55.71 (2)***
Employee pays	28.1	68.2	

† level of significance
* significant at 0.10 level
** significant at 0.05 level
*** significant at 0.01 level

The most significant difference in working conditions had to do with who pays for employee parking. Employees inside SPIDs were more than twice as likely to receive free parking from their employers. Employees outside SPIDs were more than twice as likely to have to bear the full burden of their own parking costs. The slightly more upscale and much more autonomous workers inside SPIDs were significantly more likely than those outside SPIDs to receive parking subsidies from their employers. This effect, although unanticipated from an experimental design perspective, seems reasonable on its face, given the employee demographics and working conditions found in Midtown Atlanta. The slightly higher parking rates outside SPIDs may also have contributed to this phenomenon.

Travel to Work

Over 90% of Midtown employees drove alone to work on a regular basis (see table 3). About a third had tried carpooling, and a quarter had tried MARTA rail at least once in their lives as an alternative mode of transportation for the journey to work. Only 1 in 10 Midtown employees regularly commuted using any mode of transportation other than driving alone. Half of those who did use alternative modes sometimes also drove alone on a regular basis. Driving alone is thus not only the dominant mode of transportation for work travel in Midtown Atlanta, it is overwhelmingly dominant. There were no significant differences between employees inside SPIDs and those outside, in terms of mode choice for the journey to work on either a regular or an occasional basis.

There may have been virtually no difference between sites in terms of how Midtown employees got to work. There was a major difference in where they parked their cars once they got there, however. Midtown employees outside SPIDs were 10 times as likely as those inside to park their cars offsite rather than onsite, a very significant difference. Employees outside SPIDs in this particular instance faced higher parking fees onsite, were less likely to receive parking subsidies from their employers, and had more convenient access to competitively priced commercial parking than did their confreres inside SPIDs (see figure 1).

TABLE 3 Travel to Work by Site

Travel to work	Percentage of employees: Inside SPID	Percentage of employees: Outside SPID	χ^2 (d.f.)†
Use of alternative modes:			
Never use	36.5	34.4	
Occasionally use	54.7	54.1	0.70 (2)
Regularly use	8.9	11.5	
Regular modes of travel:			
Drive alone	94.3	93.0	0.24 (1)
Carpool	5.2	5.7	0.05 (1)
MARTA bus	1.0	1.9	0.46 (1)
MARTA rail	2.6	3.2	0.10 (1)
Walk	1.0	3.2	2.02 (1)
Occasional modes of travel:			
Drive alone	2.1	5.7	3.21 (1)*‡
Carpool	30.7	33.8	0.36 (1)
MARTA bus	9.4	8.3	0.13 (1)
MARTA rail	29.7	24.2	1.31 (1)
Walk	0.5	1.3	0.57 (1)
Bicycle	5.2	1.9	2.62 (1)
Taxi	1.0	3.2	2.02 (1)
Where park:			
Onsite	96.4	63.7	
Offsite	3.6	36.3	61.52 (1)***

† level of significance
‡ statistical artefact
* significant at 0.10 level
** significant at 0.05 level
*** significant at 0.01 level

Non-Work Travel

Only one in five vehicle trips are made for commuting purposes these days (Pisarski 1992). Non-work trips, when chained together with work trips, may interfere with the ability of commuters to adopt alternative modes of travel (Bhat 1996). Midtown Atlanta employees were asked if they ever used MARTA bus or rail, walked, or rode bicycles for six varieties of non-work travel:

1. work-related business
2. personal business/errands
3. shopping/dining
4. recreation/entertainment
5. education/school
6. social/visit friends

There were few statistically significant differences between employees inside and outside SPIDs in their use of alternative modes of transportation for such non-work travel (see table 4). Overall, employees inside SPIDs were slightly more likely to use MARTA rail for non-work travel, a reasonable finding given the relative proximity of these employees to the Arts Center MARTA station. Interestingly, most of the observed difference in MARTA rail travel for non-work trips is accountable by one trip purpose, namely work-related business, though personal business/errands also contributes to the phenomenon.

PARKING PRICING

The effects of SPIDs should not be felt directly by commuters but rather indirectly. Thus, parking construction requirements, limitations, or freedoms should translate directly into parking prices, whether higher or lower. Higher parking prices associated with reduced parking supply might then result in measurable shifts in mode choice for the work trip, an indirect effect. Atlanta's SPIDs had no effect on parking supply, at least not the expected negative effect, but even this should not diminish the independent contribution of parking pricing to mode choice changes in any way. About half of the Midtown employees surveyed had to pay some or all of their parking costs (see table 2).

Oddly enough, however, paying for parking did not seem to translate into mode choice changes of any significance in Midtown Atlanta (see table 5). This is naturally somewhat disappointing, given the literature on the subject, which constantly reiterates that parking price elasticities are indeed very significant (Shoup 1995), and that demand management strategies based on parking pricing are the ones most likely to achieve measurable changes in travel behavior under normal circumstances (Higgins 1990).

Midtown Atlanta employees who paid for parking were slightly less likely to use alternative modes of transportation to get to work and slightly more likely to use three out of four alternative modes for non-work travel, but none of these measured differences were even close to being statistically significant. Furthermore, while employees who paid for parking were significantly more likely to park offsite

TABLE 4 Non-Work Travel by Site

Non-work travel	Percentage of employees: Inside SPID	Percentage of employees: Outside SPID	χ^2 (d.f.)†
Any trip purpose:			
MARTA bus	8.3	10.2	0.36 (1)
MARTA rail	64.6	55.4	3.04 (1)*
Walk	39.1	40.1	0.04 (1)
Bicycle	22.9	18.5	1.03 (1)
MARTA bus:			
Work-related business	4.2	3.8	0.03 (1)
Personal business/ errands	3.1	3.8	0.13 (1)
Shopping/dining	1.0	2.5	1.16 (1)
Recreation/ entertainment	5.2	6.4	0.22 (1)
Education/school	0.5	0.6	0.02 (1)
Social/visit friends	1.6	3.2	1.01 (1)
MARTA rail:			
Work-related business	40.6	17.2	22.54 (1)***
Personal business/ errands	26.0	15.9	5.24 (1)**
Shopping/dining	9.9	6.4	1.41 (1)
Recreation/ entertainment	44.8	42.0	0.27 (1)
Education/school	3.1	2.5	0.10 (1)
Social/visit friends	4.7	5.1	0.03 (1)
Walk:			
Work-related business	8.3	8.3	0.00 (1)
Personal business/ errands	14.1	15.9	0.24 (1)
Shopping/dining	13.5	18.5	1.58 (1)
Recreation/ entertainment	25.5	30.6	1.10 (1)
Education/school	2.1	0.6	1.28 (1)
Social/visit friends	14.6	14.6	0.00 (1)
Bicycle:			
Work-related business	1.6	0.0	2.47 (1)
Personal business/ errands	2.1	6.4	4.12 (1)** ‡
Shopping/dining	2.6	2.5	0.00 (1)
Recreation/ entertainment	20.8	17.2	0.74 (1)
Education/school	0.5	0.0	0.82 (1)
Social/visit friends	6.8	3.8	1.46 (1)

† level of significance
‡ statistical artefact
* significant at 0.10 level
** significant at 0.05 level
*** significant at 0.01 level

TABLE 5 Employee Behavior by Employer Parking Payment

Travel behavior	Employer pays for parking: No	Employer pays for parking: Yes	χ^2 (d.f.)†
Work travel: Alternative modes			
Never use	37.0	34.6	
Occasionally use	53.0	55.3	0.46 (2)
Regularly use	10.0	10.1	
Non-work travel: Alternative modes			
Bus	10.1	10.0	0.25 (1)
Rail	62.5	57.7	0.82 (1)
Walk	41.5	36.9	0.75 (1)
Bicycle	21.0	20.8	0.00 (1)
Parking location:			
Onsite	68.0	100.0	
Offsite	32.0	0.0	58.39 (1)***

† level of significance
* significant at 0.10 level
** significant at 0.05 level
*** significant at 0.01 level

than those who were entitled to receive free parking, this finding is not surprising and contributes little to science. If simple cross-tabulations cannot produce the anticipated results, it is possible that a more powerful statistical tool, such as multiple linear regression, may succeed where others have failed.

LOGISTIC REGRESSION

Preliminary results based on bivariate hypothesis testing seem to suggest that the choice of parking location varies with parking management strategies, but mode choice does not, at least not in Midtown Atlanta. These results, although mathematically quite convincing, are at least partially counterintuitive from a purely theoretical point of view. In addition, we have not yet controlled for either working conditions or demographic variables, both of which might conceivably alter some or all of these findings.

Logistic regression was performed on all dependent variables (parking location and mode choice for the work trip and for non-work travel) using a partial stepwise technique (see table 6). Building location (inside or outside SPIDs) and parking price (or rather, the level of employer parking subsidy, an inverse function of parking price) were forced into each of the equations for hypothesis testing purposes. All remaining variables (both working conditions and demographics) were forced into each equation at first and then removed one at a time until only those variables that were at least marginally statistically significant ($t \geq 1$) remained. This procedure limited mul-

TABLE 6 Employee Travel Behavior by Site, Working Conditions and Demographics

Variable	Park offsite	Use of alternative modes					
		Work trips		Non-work trips			
		Regular	Occasional	Bus	Rail	Walk	Bicycle
Intercept	2.75** (1.30)	0.23 (1.40)	0.40 (0.90)	–0.41 (1.50)	2.56** (1.03)	1.52 (0.95)	0.33 (0.94)
Outside SPID (1 = yes, 0 = no)	2.35*** (0.48)	–0.46 (0.47)	0.34	0.25 (0.46)	–0.41 (0.30)	0.22 (0.27)	–0.40 (0.31)
ln (length of employment)	–0.38** (0.17)		(0.27)** (0.10)		0.22* (0.12)		
ln (arrival time flexibility)					0.28** (0.11)		
ln (employer parking subsidy)	–0.53*** (0.12)	–0.09 (0.12)	0.04 (0.06)	–0.13 (0.11)	–0.12* (0.07)	–0.01 (0.06)	–0.01 (0.07)
Managerial (1 = yes, 0 = no)	–0.59 (0.51)					–0.64** (0.32)	
Professional (1 = yes, 0 = no)				0.64 (0.47)		–0.81*** (0.31)	
Male (1 = yes, 0 = no)	–0.50 (0.44)					–0.51* (0.28)	
Black (1 = yes, 0 = no)		1.71*** (0.52)	–0.49 (0.40)				
Graduate school (1 = yes, 0 = no)		–1.19** (0.56)	0.42 (0.27)		0.80*** (0.30)	0.49* (0.27)	
ln (income)	–0.95*** (0.32)	–0.43 (0.35)	–0.28 (0.22)	–0.60* (0.35)	–0.74*** (0.25)	–0.38* (0.22)	–0.37* (0.22)
Live outside core (1 = yes, 0 = no)		–1.84*** (0.64)	–0.32 (0.25)	–1.12** (0.53)	0.60** (0.27)		
Log likelihood—initial	–209	–209	–202	–208	–194	–216	–218
Log likelihood—at convergence	–90	–77	–194	–81	–166	–202	–160
N observations	302	301	292	300	280	311	315
Percentage correctly predicted	88	91	61	91	70	62	79

Note: Standard errors are in parentheses.
* significant at 0.10 level
** significant at 0.05 level
*** significant at 0.01 level

ticollinearity while providing maximum information on the overall statistical power of the model and each of the independent explanatory variables thus considered.

Site Effects

The regressions reaffirm the significant contribution made by building location to choice of parking location. The building site surveyed outside SPIDs was actually closer to the heart of Midtown, while the building site surveyed inside SPIDs was perched on the northern fringe of Midtown (see figure 1). The building site surveyed outside SPIDs had a somewhat higher monthly parking rate onsite ($85 vs. $65), far fewer employees who received free parking from their employers (25% vs. 57%), and much more convenient access to lower priced commercial parking (four lots within one block vs. one lot within two blocks). The site variable captures the effects of differential parking rates and availability simultaneously. Parking subsidies are treated as a separate variable in this analysis.

There was no statistically significant relationship found between building location and mode choice. There was not even a strongly identifiable pattern to the marginally significant or clearly insignificant signs in the equations. Employees outside SPIDs were less likely to commute regularly but more likely to commute occasionally via alternative modes, less likely to use MARTA rail but more likely to use MARTA bus, less likely to ride bicycles but more likely to walk for non-work travel purposes. The results shown in table 4, then, remain as a more useful guide than these insignificant regression findings.

Parking Subsidies

The elasticity of demand for offsite parking with respect to employer parking subsidies in Midtown Atlanta is both high (–0.50) and very significant ($t > 4.00$). The elasticity of demand for alternative modes of transportation with respect to employer parking subsidies is both low (circa –0.10) and barely significant ($t < 2.00$) in just one out of six cases. Removing the site variable from the equations has little effect on estimated mode choice price elasticities but increases the offsite parking price elasticity to an even higher –0.70. Thus, –0.50 is a conservative estimate of the price elasticity of demand with respect to parking location, based on these data.

Shoup (1995) identified seven case studies in which the elasticity of demand for solo automobile commuting with respect to parking price varied from a low of –0.08 to a high of –0.23, with an average of –0.15. An average of 67% of employees receiving free parking drove alone to work, versus 42% of those who had to pay for parking across Shoup's seven cases. Four of Shoup's cases are traditional CBDs, while the remaining three are large, high-density urban and suburban employment activity centers not unlike Midtown Atlanta, in terms of urban design and the built environment. The parking price elasticities measured here for regular commuting and rail and bus transit use for non-work travel are not statistically very powerful but are clearly within the range of previous studies, albeit at the low end of that range.

Feeney (1989) found that parking price elasticities can be even lower than those reported by Shoup in suburban enclaves, with a range of –0.01 to –0.05 based on the limited European examples he provides. The results found here suggest that Midtown Atlanta, with highway and transit access similar to many CBDs, in addition to a physical location just four miles north of the original Atlanta CBD, exhibits travel behavior characteristics that are perhaps a bit more like what one would expect to find somewhere out on the exurban periphery of the metropolis. The overall transit mode share in Midtown Atlanta is estimated to be about 7% (Nelson 1995). There was no increase in transit ridership observed during the second office building boom of 1986–94, however, indicating that office workers may not be the best market for transit ridership in mixed use Midtown Atlanta (see figure 3).

The upshot of these findings is that Midtown Atlanta employees are far more likely to park offsite than to stop driving alone to work in response to parking pricing. The only requirement for offsite parking is that reasonably priced, conveniently located parking alternatives must exist. Such parking alternatives might include onstreet parking in adjacent streets or offstreet parking in lots or garages. Onstreet parking can be controlled using time limits, parking meters, or residential permits. Offstreet parking can be controlled using pricing, gates, or guards. Where parking is limited in supply or high in price, spillover parking may quickly become a problem unless all parking in both the public and private sectors is controlled in one way or another to restrict access to those for whom that parking was originally intended.

Other Working Conditions

Some working conditions fared better than employer parking subsidies in the equations; others, worse. Neither average length of time spent at work (a measure of job commitment, perhaps) nor ever having worked at home (another measure of job commitment as well as work autonomy) remained in any of the equations once the stepwise regression procedure was completed, showing just how strongly insignificant these two variables were.

Length of employment was negatively associated with parking offsite, showing that walking in the rain eventually becomes a nuisance. Length of employment (i.e., seniority) surprisingly was not associated with the level of employer parking subsidies provided. In fact, other than choice of parking location, employer parking subsidies were not associated with any other variables in the analysis, with the minor exceptions of gender and race, discussed below.

Length of employment was positively associated with ever using a) any alternative to driving alone to get to work, and b) MARTA rail for any non-work travel. This presumably is a simple matter of probabilistic chance associated with longevity, as well as car reliability and job commitment. Individuals with greater flexibility in arrival time at work were more likely to have used MARTA rail for non-work travel, particularly work-related business and personal business and errands.

Demographic Effects

There were a variety of interesting demographic effects on travel behavior to complement those previously reported. Income appeared with a negative sign in all seven equations. Income was not significantly related to mode choice for the work trip, however. Income was significantly related to a lower probability of alternative mode use for non-work travel.

Residential location operated very much like the income variable in the equations, with all negative signs. Residential location appeared in only four equations, however; significantly, in only three. Midtown workers who lived outside the urban core and the MARTA service area defined by Fulton and DeKalb counties were significantly less likely to use alternative modes of transportation to get to work on a regular basis and were also significantly less likely to use MARTA rail or bus for non-work travel. The estimated effect on regular commuting, however, was much larger than the one for non-work travel using MARTA.

Age was significantly related to a few of the dependent variables, but was highly correlated with many of the other independent variables as well. This led to multicollinearity, excessively large standard errors for age and other variables, and wide fluctuations in the estimation of model parameters with and without the age variable in the model. As a result, age was eliminated from the model on an a priori basis and does not appear in any of the final equations. If age had been allowed to remain in the model, it would have appeared as a significant variable in the same equations with the same signs but larger coefficients than length of employment, a variable that does appear in the model. Thus, length of employment may be viewed as a proxy for age.

Education betrayed some interesting effects in the model. Highly educated persons were significantly less likely to use alternative modes for commuting, but significantly more likely to use MARTA rail and to walk for non-work trip purposes. Education has been shown to be negatively associated with the use of alternative modes for commuting (Ferguson 1997) and positively associated with the number of trips generated on a daily basis and with average trip length (Lave 1998).

Occupation barely made it into any of the equations. The primary finding was that managers and professionals alike were significantly less likely to walk during non-work travel. Managers' principal trips involved socializing and visiting friends; professionals' trips were for personal errands, shopping, and dining.

Within the equations, men acted much like managers and professionals, which is not surprising, given that almost 90% of Midtown men held managerial or professional job titles, as compared with 50% of Midtown women. In addition, men were significantly more likely to receive employer parking subsidies than were women in Midtown.

Blacks were significantly more likely than non-blacks to use alternative modes of travel to get to work on a regular basis. Blacks were significantly more likely to use MARTA rail to get to work on an occasional basis but significantly less likely to carpool to work on an occasional basis, producing an overall effect on the occasional use of alternative modes for commuting that was not significant.

Blacks were significantly more likely to get parking subsidies than were non-blacks in Midtown Atlanta, but this was probably a statistical artefact. A large proportion of blacks employed in Midtown Atlanta worked for building managers rather than building tenants. Building managers were among the few firms to offer free parking to all employees, for the fairly obvious reason that they had complete control of all onsite parking and relatively few employees.

MODE OF TRAVEL AND PARKING LOCATION

There may be a deeper and more significant relationship between choice of parking location and mode choice for the journey to work. If one is at least a partial substitute for the other, does this make these two apparently independent choices related to each other as extended travel behavioral alternatives? It appears that the answer to this question is yes, at least in part. With no inference regarding causality intended, it appears that alternative mode users are significantly more likely to park offsite than are dedicated solo drivers, and this propensity increases with the regularity of alternative mode use (see table 7).

The observed relationship is fairly weak but always consistent. It is statistically significant only when controlling for parking pricing. These results would be substantially improved if the sample of regular alternative mode users was larger, but this cannot be helped in the present instance. The percentages would not have to change, only the sample size on one end of the distribution, in order for most of these conditional probabilities to be significantly different from each other.

A full model of parking location would explicitly treat tradeoffs between parking price differentials, walk access times, and other characteristics of parking amenities (e.g., covered parking vs. parking exposed to the elements and parking attendant always on duty vs. empty lot). For a relatively large number of alternative parking facilities, such a model has more in common with destination choice than with mode choice models, and might benefit from the formulation of a gravity-type model interface for the more accurate estimation of model parameters.

TABLE 7 Parking Location by Work Travel, Parking Payment, and Site

	Percentage of employees who park offsite by use of alternative modes			
Conditional statements	**Regular**	**Occasional**	**Never**	**χ^2 (d.f.)†**
All employees	22.9 n = 35	20.0 n = 190	14.5 n = 124	2.04 (2)
Employee pays full cost of parking	50.0 n = 16	38.4 n = 86	23.7 n = 59	5.32 (2)*
Employee pays full cost of parking and building is located outside SPID	72.7 n = 11	51.7 n = 60	38.9 n = 36	4.11 (2)

† level of significance
* significant at 0.10 level
** significant at 0.05 level
*** significant at 0.01 level

Combining a gravity-type destination choice model for parking location with a logit-type mode choice model for work trips is certainly possible, but would not be particularly easy to accomplish and would require a much larger and more elaborate database than provided here. Consider that parking location is relevant for solo commuters, carpoolers, and bicyclists, but not for transit users and walkers. Bicycle parking is an entirely separate issue from automobile parking in most instances. Developing such a model and finding the data required to estimate its parameters might be a very worthwhile future research undertaking.

CONCLUSIONS

It appears that SPIDs were more effective in promoting commercial office development around MARTA rail stations than in promoting the use of MARTA rail for commuting to and from Midtown Atlanta. The parking provisions of SPIDs appear to have been more successful in increasing parking supply and thereby reducing spillover parking than in increasing the price of parking or inducing mode choice changes for the journey to work among Midtown commuters.

Parking price elasticities with respect to driving alone appear to be on the order of –0.10 in Midtown Atlanta. This number is somewhat on the low side perhaps but is clearly in line with previous research, at least with respect to suburban operating environments. Parking price elasticities with respect to parking location appear to be on the order of –0.5, a very significant finding in and of itself. It appears that concerns about spillover parking are not unwarranted, given the much greater elasticity of demand for parking somewhere else, as opposed to finding another way to get to work in an automobile-dominated employment environment. Spillover parking is often illegal, and where it is not illegal, it is often considered to be illicit, except where approved markets have been established, as is the case of commercial parking lots in Midtown Atlanta. Because of the illicit nature of many kinds of spillover parking, there are few, if any, previous studies that estimate the effect of parking pricing on the use of alternative parking facilities, as has been done here.

There appears to be a weak substitution effect between parking location and mode choice. That is to say, those people who are more willing to park offsite appear to be more willing to use alternative modes of travel and vice versa. On the one hand, the elimination of spillover parking might thereby induce greater use of alternative modes. On the other hand, attempts to forcibly encourage alternative mode use might easily result in spillover parking instead.

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